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Comparison of 3D and 2D acquisition of late gadolinium enhancement in patients with acute, subacute and chronic myocardial infarction

Robert Goetti[1*], Sebastian Kozerke[2], Olivio F Donati[1], Paul Stolzmann[1], Roberto Corti[1], Robert Manka[1]

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Purpose

To assess a late gadolinium enhancement (LGE) imaging single breath-hold 3D inversion recovery sequence for the quantification of myocardial scar mass and transmurality in comparison to a clinically established 2D acquisition sequence.

Methods

Ninety patients (84 men, age 54.4±10.8y, BMI 27.8±4.5 kg/m^2) with acute (n=30), subacute (n=30) and chronic (n=30) myocardial infarction were included in the study. All imaging was performed on a 1.5-T clinical MR system (Achieva, Philips Medical Systems, Best, the Netherlands). Spatial resolution was identical for 3D and 2D images (1.5 x 1.5 mm^2, slice thickness 8 mm, no slice gap). Image quality was graded on a five-point scale (1: excellent, 5: non-diagnostic). Quantitative analyses of myocardial mass (g), scar mass (g) and scar transmurality (five-point scale: 0: 0%; 1: <25%; 2: <50%; 3: <75%; 4: 75%-100%) were performed. Intra- and interobserver agreement were assessed for 15 randomly chosen patients (5 of each group).

Results

Mean image quality was not significantly different in 3D (1.50±0.675) and 2D (1.41±0.669; p=0.26) datasets. Non-diagnostic image quality (score: 5) did not occur. Acquisition time was significantly shorter for 3D datasets (26.7±4.4 sec vs. 367.7±56.4 sec; p<0.001). There were no significant differences between 2D and 3D datasets in mean myocardial mass (2D: 148.3 ± 35.1 g; 3D: 148.1 ± 34.6 g; p=0.76) and scar tissue mass (2D: 31.8 ± 14.6 g; 3D: 31.6 ± 15.5 g; p=0.39) with strong and significant correlation between 2D and 3D datasets regarding both myocardial mass (r=0.982; p<0.001) and scar tissue mass (r=0.980; p<0.001). Bland-Altman analysis showed a mean difference of 0.21±6.64 g (range: -19.64 - 18.44 g) for myocardial mass and a mean difference of 0.26 ±2.88 g (range: -7.15 - 7.74 g) for scar mass between 2D and 3D datasets. Agreement between the two acquisition techniques regarding scar transmurality was excellent for the detection of non-viable segments (>50% scar tissue transmurality; κ = 0.81) and was good (κ = 0.75) for the more detailed assessment using the five-point transmurality score. Inter- and intra-observer agreements were good to excellent (κ = 0.70-0.90).

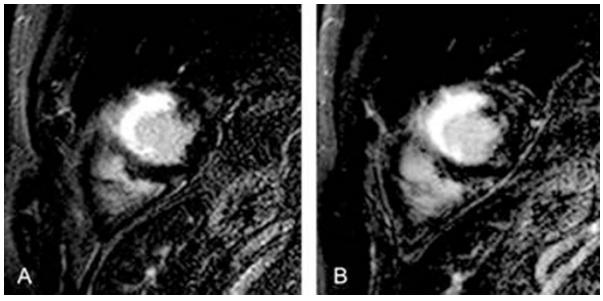

Figure 1 Images of 2D (A) and 3D (B) acquisitions in a 48 y/o male with acute myocardial infarction showing equal image quality and delayed enhancement extent.

Conclusions

3D LGE imaging enables accurate quantitative evaluation of scar tissue mass and transmurality with significantly shorter acquisition time compared to 2D LGE imaging.

[1]University Hospital Zurich, Zurich, Switzerland
Full list of author information is available at the end of the article

Author details
[1]University Hospital Zurich, Zurich, Switzerland. [2]ETH Zurich, Zurich, Switzerland.

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